Effects of human habituation on anti-predator behavior of *Ctenosaura similis*

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Abstract: Animals respond differently to human presence according to their risk perception. At Palo Verde National Park, Costa Rica, ctenosaurs (*Ctenosaura similis*) occur both in close proximity to the OTS field station and in the surrounding dry forest. We hypothesized that field station ctenosaurs are habituated to constant non-predatory human presence and would be less wary of human approach compared to woodland-dwelling ctenosaurs. Station ctenosaurs tended to allow closer human approach (shorter approach distance) and to travel shorter distances in initial flight from human approachers relative to those in woodlands. Most station ctenosaurs (59%) did not return to a shelter when pursued. Among woodland ctenosaurs, distance from shelter was positively correlated with approach distance and significantly greater for adults than for sub-adults. The behavior of large, diurnally-active fauna like ctenosaurs may be sensitive to human encroachment. It seems appropriate that wildlife management should strive to preserve natural behavior, in addition to preserving population survival.

Key Words: behavioral diversity, habitat encroachment, tameness

Introduction

Human encroachment on wildlands can alter behavioral patterns of native animals. Humans frequently prey on wildlife, inducing greater levels of wariness in local populations (Delibes and Blasquez 1998). Human settlements, however, can also serve as novel safe havens for wild species. In areas of such artificial safety, animals accustomed to escaping wild predators may lose or suppress evolved wariness traits. The behavior of large, diurnally-active fauna like ctenosaurs may be sensitive to human encroachment. This loss may be characterized as a reduction in behavioral diversity, and may even shift the evolutionary path of the species (McNab 1994).

Populations of ctenosaurs (*Ctenosaura similis*), large lizards typically found in tropical dry forest, are exposed to a gradient of human traffic in Palo Verde National Park, Costa Rica. Burger et al. (1991) showed that ctenosaurs found close to the OTS field station had become habituated to humans and often ignored them, whereas those in the nearby forest fled at the sight of people. We evaluated the hypothesis that prolonged exposure to human traffic alters the anti-predator behavior of ctenosaurs. Under this hypothesis, ctenosaurs in the immediate vicinity of the OTS Field Station would be less wary of humans than ctenosaurs in surrounding woodlands. Specifically, we tested the prediction that station ctenosaurs would allow humans to approach to a closer distance, move a shorter distance during their first flight, and be found farther from their shelters than woodland ctenosaurs.

Methods

Two study sites were chosen to represent areas of high and low human traffic. The cleared area surrounding the OTS Palo Verde Field Station served as an area of high human traffic. The low traffic site encompassed areas more than 200 m from the Field Station, including the abandoned airstrip, the campground, and several clearings located along the road and in the forest west of the station. These two ctenosaur populations are referred to as station and woodland, respectively.

We selected three response variables to quantify ctenosaur wariness to human approach. Approach distance was defined as the minimum distance a human could approach a ctenosaur before the ctenosaur responded by moving at least three steps. First flight distance was the distance of continuous ctenosaur movement during its first response to human approach. Shelter distance was the distance between a ctenosaur's basking location and, if applicable, the place where it ultimately took shelter from the approacher (tree or burrow).

To measure these three variables, we first sighted a ctenosaur at a distance that did not elicit a response, and then approached the animal at a rate of 1 stride/s. The approacher pursued the lizard at the same pace until it reached shelter or was out of sight. An observer recorded initial basking location, first flight distance and shelter distance (if applicable) of the focal individual. This procedure was repeated for 25 ctenosaurs at the field station (high traffic) and 20 woodland ctenosaurs (low traffic). Each ctenosaur was classified as either sub-adult (total length < 30 cm), or adult (total length > 30 cm). All data were collected between 10:00 am and 12:00 pm on 10-11 January 2000. Both days were sunny and clear. Data were analyzed with a Student's t-test and linear regression. Flight distance data were normalized by common-log transformation.

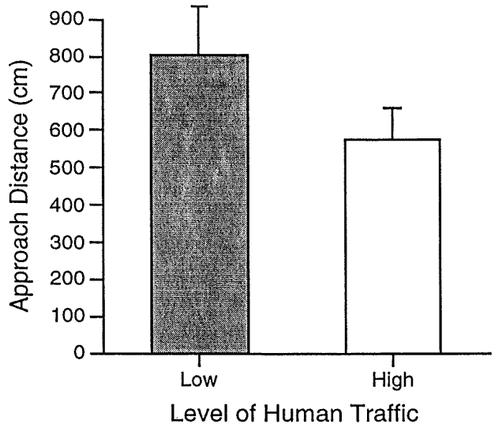

Fig. 1. Effect of the level of human traffic on the approach distance of *Ctenosaura similis* (F = 3.04, df = 39, p = 0.09).

Results

Both approach distance and flight distance were shorter for station ctenosaurs than for woodland ctenosaurs, although these differences were not significant (Figs. 1 and 2).

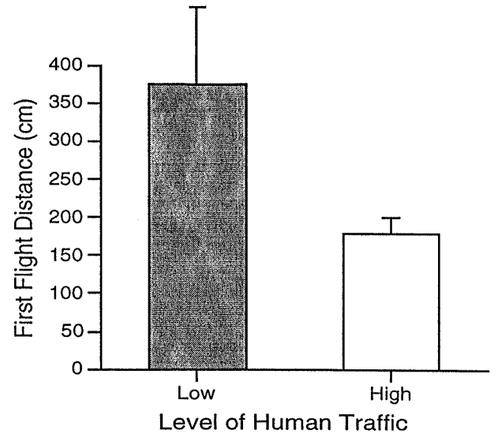

Fig. 2. Effect of the level of human traffic on the flight distance of *Ctenosaura similis* (F = 2.51, df = 1.31, p = 0.12).

Among woodland ctenosaurs, adults basked at a significantly greater distance from their shelter than sub-adults (Fig. 3). Approach distance in woodland ctenosaurs, but not station

Fig. 3. Effect of age class on shelter distance for the woodland *Ctenosaura similis* population (F = 4.76, df = 1.17, p = 0.04).

ctenosaurs, was positively correlated with shelter distance (Fig. 4; $r^2 = 0.23$, $p = 0.04$). When pursued, 59% of station ctenosaurs did not return to a specific shelter, while all of the woodland ctenosaurs returned to a shelter (chi-square = 16.44, $p < 0.0001$).

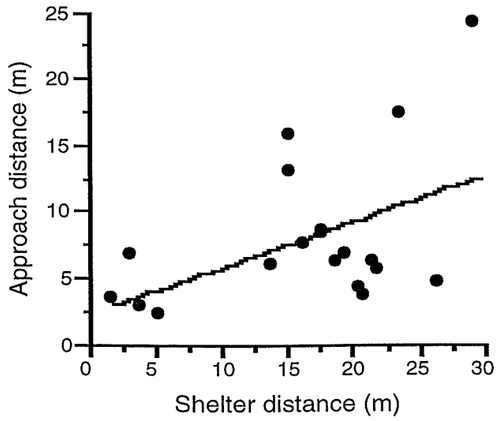

Figure 4. The distance at which woodland ctenosaurs fled from an approaching human was positively correlated with the distance of ctenosaurs from their shelter ($r^2 = 0.23$, $p = 0.04$).

Discussion

Our analyses of approach and flight distance suggest decreased wariness among ctenosaurs at the station (high traffic) relative to those in woodlands (low traffic). Furthermore, the majority of station ctenosaurs were either too far from their shelter to run directly to it, or did not deem it necessary to take shelter when pursued by humans. In contrast, the positive correlation between approach and shelter distance for woodland ctenosaurs suggests that the human approacher was perceived as a threat in this population.

The relative tameness of station ctenosaurs may result from the increased security provided by additional shelters around human habitation, the low occurrence of natural predators around human settlement, and/or ctenosaur perception of humans as non-threatening (a possible consequence of laws prohibiting hunting within National Park boundaries). Similarly, woodland ctenosaurs may be more wary than station ctenosaurs because they lack experience with humans and because woodland ctenosaurs are frequently exposed to natural predators. It should be noted that even the woodland population in Palo Verde is exposed to some human traffic, as most individuals in this population were found < 200 m from a road. It would be valuable to study ctenosaur populations in less developed areas to further examine the impact of human traffic on ctenosaur behavior.

Our results for woodland (low traffic) ctenosaurs indicate that wariness decreases with age, which is contrary to findings by Janzen (1983). If our conclusions are valid, adults may be less wary to a perceived predator than sub-adults because their large size makes them less vulnerable and/or because they have become more conditioned to human presence.

The origin of the behavioral trends observed in our experimental populations has important implications for conservation. It seems unlikely that the variation is genetically based, because most of the station and woodland populations were within 1 km of each other. More likely, the behavioral changes are a function of conditioning over the lifetime of the individual. If this is the case, ctenosaurs are capable of high behavioral plasticity and are not losing behavioral diversity (McNab 1994), so much as extending their repertoire of responses. Informed decisions about land use and species conservation depend upon an awareness of the wide range of potential impacts people can have on wild populations. Preservation of behavioral traits that existed before human contact merits consideration in wildlife management and conservation biology.

Literature Cited

Burger, J., M. Gochfeld, and B.G. Murray Jr. 1991. Role of a predator's eye size in risk perception by basking black iguana, *Ctenosaura similis*. Animal Behavior 42: 471-76.

Delibes, M., and M.C. Blasquez. 1998. Tameness of insular lizards and loss of biological diversity. Conservation Biology 12: 1142-1143.

Fitch, H.S., and J. Hackforth-Jones. 1983. *Ctenosaura similis*. Pp. 394-6 *in* D.H. Janzen, editor. Costa Rican Natural History. University of Chicago Press, Chicago, IL.

McNab, B.K. 1994. Energy conservation and the evolution of flightlessness in birds. American Naturalist 144: 628-642.